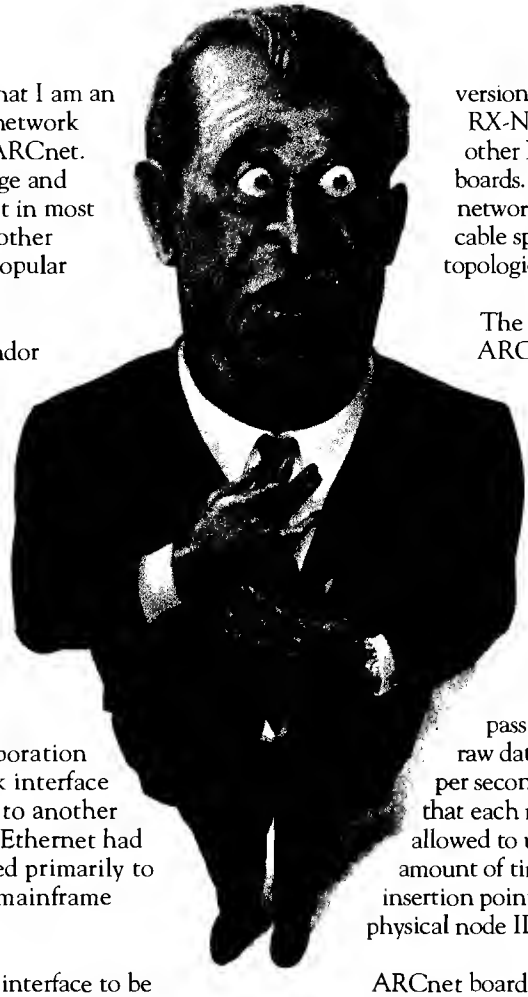
column

ARCnet

The Rodney Dangerfield of Network Computing

By Mickey Applebaum



For the record, let me just admit that I am an ARCnet fanatic. I have yet to find a network that could not run, and run well, on ARCnet. ARCnet is inexpensive, easy to manage and install, and virtually as fast as Ethernet in most situations. Still, it is losing ground to other network protocols, partly because of popular misconceptions.

ARCnet is the only truly multivendor standard network interface board manufactured today: No matter whose ARCnet board you buy, there is a 95 percent chance that it will work with your network driver. This compatibility is a result of ARCnet's unique history. (I should mention that the Token Ring Tropic chipset is beginning to standardize Token Ring.)

In the ARCnet Beginning . . .

In the late 1970s, Datapoint Corporation developed ARCnet, the first network interface to transport data from one computer to another over flexible coaxial cable (RG-62). Ethernet had been developed earlier, but it was used primarily to connect large, expensive printers to mainframe computer systems.

ARCnet was also the first network interface to be brought to the personal computer in the early 1980s. Datapoint developed a specialized communications chipset, later changing it to a sealed Large Scale Integration (LSI) component, which reduced the cost of manufacturing ARCnet network interface boards. Datapoint still owns the rights to the LSI component and licenses the technology to other ARCnet manufacturers, which is why there is a standard driver interface.

When Novell developed NetWare, ARCnet was one of the first protocols supported. Novell even had its own version of the ARCnet board, the RX-Net board—released before other Novell network interface boards. ARCnet was also the first network board to support multiple cable specifications and topologies.

The unfortunate part of ARCnet's history is that until 1992, it was never a "standard" protocol. In 1992, the ANSI specification committee finally wrote an ARCnet protocol standard.

How Does ARCnet Work?

ARCnet is a token-passing protocol running at raw data throughput of 2.5MB per second. Token passing means that each network interface board is allowed to use the cable for a specific amount of time. Stations arbitrate their insertion points based on each board's physical node ID.

ARCnet boards use physical node IDs configured by the network supervisor. Ethernet and Token Ring, on the other hand, can use locally administered logical node IDs, but their physical node IDs are burned into ROM.

ARCnet boards can be configured for any of 255 physical node IDs (1 through 255; 0 is used for internal timing and addressing functions). When ARCnet boards power on or reset, they perform a network reconfiguration (RECON), which can be compared to an army troop doing a soundoff. Each station sends a node ID broadcast and compares it to all the other node

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IDs. The station with the lowest ID arbitrates the soundoff and finds the next highest number. The system continues from there.

Token passing also means that ARCnet is tolerant of high-volume traffic. Since each node takes a turn on the cable, the cable does not become saturated when it has to transmit large amounts of data or data from a large number of workstations. Each node knows when it can get access to the cable and how much data it can place on the cable in each timing cycle.

ARCnet's performance will be the same whether the cable is at 5 percent utilization or 85 percent utilization. This means that actual node throughput on the network doesn't degrade under load as it does with collision detection network protocols such as Ethernet.

So What's Wrong with ARCnet?

With all these things in its favor, why isn't ARCnet the most popular network protocol? As a true ARCnet devotee, I have asked myself that question many times. Here are the reasons why I think ARCnet is losing its popularity and is not being considered for new installations.

- Reduced cost for Ethernet network interface boards
- No support for Simple Network Management Protocol (SNMP) systems or management systems used by 10Base-T networks
- A misguided belief that Ethernet is *significantly* faster
- Limited number of nodes allowed

The first two reasons can't be argued, and for large internetworks that require remote management, Ethernet and Token Ring provide much better options. To give ARCnet its due, however, the largest manufacturers of ARCnet products (such as SMC and Thomas Conrad Corp.) have their own ARCnet hub management protocols. The biggest problem with these

ARCnet Cabling and Topology

ARCnet is capable of running on coaxial cable (RG-62, 93 Ohm), single twisted pair (100 Ohm), and fiber optic. ARCnet supports twisted pair through the use of on-board twisted pair transceivers or through the use of coaxial to twisted pair baluns.

ARCnet can run in its native distributed star bus, linear bus, and modified star bus (multiple linear busses starred off a single hub). In its native star bus, ARCnet works with a combination of active and passive hubs and active links. The network interface board in each node is considered an active device, as are active hubs and active links.

The difference between an active hub and an active link is simply the number of ports on the device. An active link has two ports, and an active hub has multiple ports (usually 4, 8, or 16). Any two ARCnet nodes can be directly connected, connected through a combination of active hubs or active links with up to 10 active devices between nodes, or connected through a passive hub or combination of passive and active hubs.

Coaxial

ARCnet can support the following distances for coaxial connections:

- Star topology, active device to active device: 2,000 feet. This can be node to node, node to active hub, active hub to active hub. A maximum of nine active hubs are allowed between any two nodes.
- Star topology, active device to passive device: 100 feet. This can be node to passive hub or passive hub to active hub. You cannot connect a passive hub to another passive hub. You must terminate all unused passive hub ports.
- Bus topology, terminator to terminator: 1,000 feet. This must be Hi-Z or high impedance boards only. You may have up to eight nodes connected to each linear bus. Each end of the bus must be terminated with a 93-ohm termination resistor or with a workstation using an ARCnet board. This raises the limit to 10 nodes. An active hub port can be used as a terminator on the linear bus. Passive hubs are not allowed on a linear bus.

Twisted Pair

ARCnet on twisted pair is as easy, since there has never been a true standard for ARCnet twisted pair. The most common distance limitation for twisted pair ARCnet is 400 feet with a linear bus topology and input and output connectors on each board. Thomas Conrad Corp. has an alternative transceiver design that allows for cable distances of up to 800 feet. Twisted pair ARCnet requires that each end of the twisted pair bus be terminated with a 100-Ohm termination block, which can be a twisted pair active hub. With twisted pair, you can have up to 10 nodes on each linear bus.

You can also connect a standard star bus coaxial board to twisted pair cabling through the use of a coaxial to twisted pair balun. In this configuration, though, you can only have one station per cable, and it must connect to a matched balun on a coax active hub at the other end.

Fiber Optic

ARCnet on fiber optic can run several kilometers between active devices. This is the most common use for an active link or a two-port active hub. The active link is simpler than an active hub and allows the maximum distance between nodes.

management protocols is that they are not interchangeable and, therefore, do not allow for a standard management system interface such as SNMP or NetView.

As for the third concern, although Ethernet has a faster raw data throughput (bandwidth) of 10Mbit/s, the actual data throughput of the current 16-bit Ethernet boards is virtually the same as today's 16-bit ARCnet boards. For example, in my own performance tests using PERFORM2 on my personal network (386SX/16 workstation, 386DX/25 file server, 300MB Maxtor 4380S hard disk attached to a ProComp F-DCB using the DRA.DSK driver with 8MB of RAM installed), I obtained the following results:

- Thomas Conrad 6142 8-bit ARCnet board in server and station: 100kbit/s throughput
- SMC PC600FS ARCnet board in the server and station: 145kbit/s
- 3COM 3C503 EtherLink II in server and station: 135kbit/s
- 3COM 3C503-16 EtherLink II/16 in the server and station: 185kbit/s

> Token passing means that ARCnet is tolerant of high-volume traffic. Performance will be the same whether the cable is at 5 percent utilization or 85 percent utilization.

As you can see, although Ethernet is faster, it is not significantly so. In practical terms, the speed difference between ARCnet and Ethernet comes down to this: saving a 35KB WordPerfect document takes .241 seconds with ARCnet and .189 seconds with Ethernet. Is a savings of .052 seconds worth the expense? Furthermore, for my tests I used a single workstation and a single server. Because Ethernet is a collision detection network protocol, it will show signs of performance degradation under higher packet loads.

The fourth argument against ARCnet—that it allows a limited number of nodes—is not really valid. ARCnet allows up to 255 nodes on a single segment. If you need more nodes, you can either add more network interface boards to the file server or use NetWare routers (ROUTEGEN or NetWare MultiProtocol Router) to increase the number of segments.

In a NetWare 2.2 file server with its limit of four network interface boards, you can have 1,016 workstations without using an external NetWare router. In a NetWare 3.11 or 4.0 file server with its limit of 16 network interface boards, you can have 4,064 workstations without using an external router.

Compare these limits to those of NetWare itself on a single server—100 users for NetWare 2.2, 250 users for NetWare 3.11, and 1,000 users for NetWare 4.0—and you can see that ARCnet allows many more physical connections than you have user slots in the operating system. Furthermore, you can have up to 254 routers on any one segment, and each of those routers can have between 762 (NetWare 2.x ROUTEGEN) and 3,810 (NetWare MultiProtocol Router) workstations attached to it.

ARCnet's Future

There are two exciting developments in ARCnet's future. Datapoint, the originator of ARCnet, has produced a 20Mbit/s version of the ARCnet protocol called ARCnet Plus. ARCnet Plus uses the same coaxial cabling as ARCnet, and you can use both the new 20Mbit/s boards and the old 2.5Mbit/s boards on the same cabling segment. In addition, the new ARCnet Plus hubs will automatically arbitrate the speed between the nodes. ARCnet Plus can be an easy way to obtain a faster network; the only network-wide requirement is that you have to replace all active and passive ARCnet hubs with ARCnet Plus active hubs.

The other exciting development is the Thomas Conrad Network Solution (TCNS), a 100Mbit/s protocol that uses ARCnet's token-passing scheme with standard ARCnet and Enhanced ARCnet network drivers. TCNS supports three different cabling options: coaxial, IBM Type 1 shielded twisted pair, or fiber optic. With coaxial cabling, you can maintain compatibility with the installed base of ARCnet StarBus systems.

Using the 16-bit TCNS boards in my personal network, I get a throughput of 450kbit/s as compared to ARCnet's 145kbit/s. Even using the Novell EMSNETX and a slow 16-bit memory expansion board with QEMM as the memory manager, I get 325kbit/s throughput. Using the same 16-bit TCNS boards in a 486DX/33 file server and workstation at my office, we consistently get 1300kbit/s throughput.

So spread the word. Low cost, ease of installation and maintenance, and simple management at the workstation and hub level all give ARCnet a place in the world of networking for both small and large installations. Help bring some respect back to this Rodney Dangerfield of networking; it is still a viable network protocol solution, even though lots of folks just haven't heard of it.

Mickey Applebaum works for Uinta Business Systems in Salt Lake City, Utah. He also spends thousands of hours each year on CompuServe as a NetWire system operator (sysop). ■